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DAIRY INDUSTRY.
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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF DAIRY INDUSTRY
Washington, D. C.

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SUGGESTED METHODS FOR REDUCING MILK PRODUCTION AND CURTAILING SALES UNDER THE AAA PROGRAM

If the dairy industry should adopt the proposed AAA program for reducing individual farm sales of milk and butterfat below the average for 1932 and 1933, the question arises as to how the individual dairy farmer can best reduce his production or limit his sales of milk and butterfat to meet the requirements of his contract.

The method or methods of reducing production or limiting sales will be entirely optional with the dairy farmer himself, but the various State Extension services can perform a very helpful service by making carefully thought out suggestions, based on sound dairy-management practices. The exact recommendations, of course, will vary in different sections of the country and according to local conditions.

In general these suggestions will relate to economical methods of reducing the quantity of milk and butterfat produced, through changes in the herd management and feeding practices, and to ways of using greater quantities of the milk and butterfat on the farm. Feeding and farming practices that result in cutting the cost of milk production should benefit the individual dairy farmer, whether the milk-production control program is adopted or not.

CULL UNSOUND AND LOW-PRODUCING COWS

Our cow population has increased markedly (18%) during the last 6 years, with consequent increased production. Normally some 4½ million dairy cows are

culled annually, but normal culling has not taken place during this period. Some dairymen have held on to their culls, hoping that the Federal Government would buy them up at higher figures than the packers will pay. These hopes are not to be realized.

There are few herds in the country that do not have one or more unsound or recognized unprofitable cows that should be slaughtered. The culling of these cows is logical, not only as a means of reducing milk production of the herd, but also as a means of improving practices and making production more efficient.

Even in dairy herd-improvement associations, where the average production is well above that of the average of all milking cows in the United States, one-third of the cows are producing milk at a loss, one-third are just breaking even, and only one-third are making a profit over feed cost. The better cows are carrying the loss on the poorer cows, a fact of which the owner is often unaware.

Thousands of dairymen are feeding and milking low-producing or unprofitable cows, when they might easily raise the average production of their herds, make a greater profit by keeping fewer but better cows, and put less milk and butterfat on the market. For example, cows producing 200 pounds of butterfat a year in these herd-improvement associations in 1932 had a feed cost of $27.50 per cow per year; whereas cows producing 400 pounds of butterfat had a feed cost of $36.50 per cow per year. On this basis, if butterfat were selling at 20 cents a pound, a farmer could obtain $1,000 income over feed cost from a herd of 80 cows producing 200 pounds of butterfat each, or from a herd of 23 cows producing 400 pounds of butterfat each. Furthermore, the 23 good cows would put only

9,200 pounds of butterfat on the market in a year, whereas the 80 poorer cows would put 16,000 pounds on the market. Such records as these indicate conclusively that the low-producing cow is largely responsible for the surplus of dairy products.

Culling low-producing cows from the herd is good practice at all times. It is especially good practice now with such low prices for dairy products. A word of caution is essential here, however, so as not to encourage unduly the sending of excessive numbers of cull cows to the packers. The packers probably cannot absorb all these cows at once without greatly depressing the market, so it looks like the feasible thing is for the farmer to dry off the cull cows and turn them on good pasture to fatten so they may be sent to market in orderly numbers later, and in a condition in which they will make a better quality of meat.

Furthermore, almost any farm family could use at least one cow for meat right on the farm, and thus keep her off the glutted meat market. The market should be able to absorb the normal supply of 4½ million culls during the year, but if in addition each dairy-farm family were to consume one carcass this would account for an additional 4 million head. If this number of the lower producing cows were taken out of production it would mean a reduction of approximately 25 percent of the present number of milk cows; and should result in reducing the total milk production by from 12 to 15 percent, according to computations based on dairy herd-improvement association records.

Intelligent Culling

Culling, to be the most beneficial from the long-time standpoint, should be done intelligently; that is, it should be based on the actual production records of the individual cows in the herd. Dairymen sometimes feel that they can determine what their cows are producing without any sort of testing. The fallacy

of this notion has been disproved by actual trial many times. For example, at the time two dairy herd-improvement associations were formed, 14 farmers estimated the milk production of their cows before the testing work began and 5 of them estimated the butterfat production. The estimates included the individual yearly milk production for 102 cows and the butterfat production for 48 cows. Compared with the actual production as shown by the records at the end of the testing year, the estimates for both milk and butterfat were off by from 1 to 50 percent. The average error on milk production was 25 percent and on butterfat 28 percent.

Membership in a dairy herd-improvement association is usually the most satisfactory and economical way for a dairy farmer to obtain the necessary records for intelligent culling. Expansion of this type of testing, which at present includes about 300,000 cows in about 14,000 herds, would give many more dairymen valuable information on which to base their culling operations in the near future, and would of course benefit them from the standpoint of furnishing information for better feeding and for herd-improvement through breeding. Membership in one of these associations usually costs about $3 per cow.

Records also give the best kind of a check on feeding methods. One does not have to guess at results when accurate records are available. They will also indicate which are the cows whose calves should be saved in order to increase the efficiency of the herd. Economy of production is what we are striving for and an efficient herd is the keystone of economical production. This leads to the subject of breeding.

IMPROVING HERDS THROUGH BREEDING

While a breeding program is necessarily more of a long-time project, dairymen should be considering the future as well as the present emergency.

The keeping of records enables the dairyman to intelligently improve his herd through breeding. As pointed out, he can select the cows that will be the mothers of the future herd. He can also check up on the transmitting ability of his herd sires and continue to use only those sires that improve the herd. More net income would be made by the dairymen of the country if the herds were improved to the point where the country's needs could be supplied by 2/3 of the present number of cows. This is possible through better breeding.

Remove Diseased Animals

A fund of $5,000,000 has been appropriated to hasten tuberculosis testing and the removal of tuberculous cattle. It is estimated that some 600,000 head of these cattle will be made into tankage as a result of this campaign.

Plans are also being drawn that may make possible the eradication of Bang's disease and infectious mammitis. Whether or not indemnity is paid for diseased cattle removed certainly no dairyman can afford, under present conditions, to tolerate these pernicious diseases in his herd. If the herd is infected, the owner should be sure to keep eradication of diseased animals in mind when laying plans for production control.

RAISE FEWER CALVES

Feed Milk on Farm to Calves, Hogs, and Poultry

It has been pointed out that one of the reasons for the present dairy situation is the abnormally large number of cows being milked. This was predicted several years ago on the basis of returns showing larger numbers of heifers raised for replacements.

The opposite procedure can now well be the order of the day. The principles to follow should then be:

1. Kill all grade bull-calves and bull calves from low-producing registered cows, or raise them for veal only.

2. Kill all heifer calves out of low-producing cows, whether grades or purebreds, as well as those that are weak and undersized, or raise them for veal only.

3. Raise only a sufficient number of heifer calves, from the best producing cows and sired by good registered bulls, to maintain but not increase the size of the dairy herd.

Heifer calves intended for replacement should be fed so that their maximum dairy development will be assured. As one of the alternative methods in accomplishing control of production the liberal use of whole milk for feeding replacement heifer calves as well as for the veal calves, will result in withholding considerable quantities from the market, and at the same time contribute to the development of the heifer calves. Replacement heifer calves and veal calves can well be fed whole milk from 8 to 12 weeks as a part of the control plan. Each such calf will account for 600 to 1,600 pounds of whole milk during this period, in addition to the curtailed amounts of grain and legume hay necessary. Incidentally hogs and chickens can be fed whole milk to good advantage as a means of limiting sales from the farm.

Good dairy management means keeping labor costs low. Labor is quite an item in raising dairy calves, and it may be found expedient during this period of emergency to use the lower producing cows, low testing cows, or those cows well along in lactation as nurse cows for these replacement or veal calves. This applies particularly to beef cows.

BREED HEIFERS LATER

Studies by the Bureau of Dairy Industry from records of dairy cows in dairy herd-improvement associations show that within the breed the larger

cows excel in milk and in butterfat production. Other studies show that the greater the production per cow the greater the income over cost of feed. Combining the results of these two studies with the need for curtailment of production leaves the age old slogan "fewer but better cows."

The start in obtaining these good high producing cows is in the breeding, but starting with the heifer calf the dairyman's problem is in obtaining size and condition at the time of freshening. Holding off breeding until the heifer is at least 18 months of age will afford opportunity to feed for maximum development. At the same time with the need for curtailment of production from the herd as a whole, this delay in breeding will keep several months' production of each such heifers off the market. There is also somewhat of a labor saving feature to this method in that it is easier to care for a heifer not in milk than for one that is in production.

REDUCE DAILY MILKINGS

Another way to curtail production, which will have only a limited application, is to reduce the number of milkings from 3 or 4 times a day to only 2 times a day.

Some dairymen milk their high-producing cows 3 times per day. Other dairymen utilize three-times-a-day milking as a regular part of their management program during those parts of the year when labor is not used in the fields.

Studies have been made on the influence of extra milkings on production. The increase to be expected by milking cows 3 times a day instead of twice will vary from about 10 percent for short periods of a month or so to 20 percent or more for whole lactations. Cows milked 3 times a day produce more persistently. The percentage of butterfat in the milk is not affected. The consensus among dairymen who have practiced 3-times-a-day milking is that the additional milk produced will be about 15 percent.

Reducing the number of daily milkings to two a day, in herds now milked 3 or 4 times a day, may offer a partial solution to the curtailment of production. There will also be a corresponding curtailment in the labor requirements necessary for milking, and also in the feed requirements.

USE MORE DAIRY PRODUCTS ON THE FARM

There is a decided need for a greater consumption of fluid milk on farms as well as in cities in the diets for adults as well as children. The Bureau of Home Economics says the value of milk in the diet of the adult seems almost eclipsed in the public mind by the emphasis placed on the importance of milk in infancy and childhood. And yet nutritionists constantly call attention to the whole family's need for milk and its products because of their nutritive value. Milk contributes more to good nutrition than does any other single food.

Milk is an outstanding source of calcium - so essential to strong bones and teeth. It contains vitamins A and B which promote growth and resistance to disease. It furnishes a high quality of protein used in building and repairing tissues. A quart of milk a day is desirable for every child under 16 years, and is essential for best growth and development in children under 6.

For adults, milk is needed to maintain health and vigor. Those adults who belittle the idea that they need milk forget that the calcium requirement is continuous throughout life. A good standard is a pint of milk daily for everyone.

The average amount of milk per person used in this country is very low in relation to the amount desirable. Since milk is a food required by all members of the family, both young and old, the milk pitcher should be found on the table at every meal.

There are 4,500,000 farms on which cows are being milked. Assuming an average of 5 persons per farm, or 22,500,000 persons in all, if each person on these farms consumed an additional glass of milk per day it would require a total of 500,000,000 gallons of milk to supply this additional consumption. In other words, using this amount of milk on farms where it is produced would be an admirable way for the farm family to keep it off the market.

No remarks concerning the consumption of dairy products are complete without emphasizing the importance of quality. People eat greater quantities of dairy products that are palatable and of good quality. This applies to farm families as well as to city people. The farmer who goes to extra effort to produce milk under the most sanitary conditions, to cool it promptly, and to keep it cool will find that he has a more valuable food product, either for home consumption or for the market.

But quality is not limited to flavor and palatability. The Bureau of Dairy Industry has found that milk produced on good grass and hay is far superior in vitamin A content to milk produced on dry feed. Without vitamin A young animals cannot grow and are subject to various fatal infections. Vitamin A is just as necessary for people. In connection with the Department of Agriculture's broad program for turning cultivated lands into pastures and forage crops there is the opportunity for dairy farmers not only to produce milk more economically but to produce milk with a greater vitamin A content.

GROW AND FEED LESS GRAIN AND MORE ROUGHAGE TO CUT MILK PRODUCTION AND FEED COST

Farmers in some sections of the country would find it advantageous to reduce the total milk production on their farms by changing their system of farming and feeding to one in which they would keep most of their land in

permanent pasture grasses and legumes, and grow very little if any grain. The pastures and roughage crops would be the basal ration, and grain would be fed only when the resultant increase in production would warrant.

Many feeding trials by the Bureau of Dairy Industry indicate that when cows are fed a good quality of roughage, and the grain ration is cut to 1 pound for each 6 pounds of milk produced, the milk yield is about 10 percent less than when the grain ration is twice as much. When a good quality of roughage is fed as the sole ration the milk yield is about 30 percent less than when the full-grain ration is fed with the roughage.

This drop in milk production, either when the grain ration is cut in two or eliminated entirely, does not involve a corresponding drop in profits. Usually the cost of producing the necessary feed nutrients in the form of roughage is so much less than in the form of grain - less than half as much in many cases - that it pays to grow the dairy ration in the form of roughage instead of in the form of grain. The drop of 10 or 30 percent in milk yield is more than offset by the reduced feed cost.

A good quality of roughage is essential, and better results are obtained from the cows accustomed to eating large quantities of roughage.

Dairy farmers who have a good quality of roughage already available, or are in position to grow it this summer, can feed more roughage and less grain as an economical method of curtailing production immediately to meet the requirements of their contract under the AAA production-control program. But, because growing and feeding more home-grown roughages enables the farmer to produce milk at the lowest cost, the practice is desirable from the long-time point of view whether total milk production is to be curtailed or not.

Comparative Milk Production on Full-grain, Half-grain, and Roughage-alone Rations

Several years ago the Bureau of Dairy Industry conducted experiments on three planes of feeding in which one group of cows was fed a full-grain ration at the rate of 1 pound of grain to each 3 pounds of milk together with all of the good alfalfa hay, silage and pasture that they would consume. The same cows were later fed a limited-grain ration, that is, 1 pound of grain to each 6 pounds of milk, together with all of the alfalfa hay, silage and pasture they would consume. These same cows were later fed a ration consisting of roughage alone, that is, alfalfa hay, silage and pasture, with no grain.

When these cows were fed the full-grain ration they produced an average of 17,851 pounds of milk and 620 pounds of fat. When they were on the limited-grain ration they produced an average of 16,649 pounds of milk and 584 pounds of fat. On roughage alone they produced an average of 13,657 pounds of milk and 478 pounds of fat. All of the above records are calculated to maturity for comparison. The average production of 478 pounds of fat on roughage alone is a rather remarkable demonstration of the production that can be expected from cows fed nothing but roughage. It was extremely economical production.

The Bureau has continued this work and has fed a large number of cows by alfalfa hay alone. At the present time, 15 cows have completed 21 yearly records under these conditions. They have produced an average of 11,010 pounds of milk and 390 pounds of fat on alfalfa hay alone. (Calculated to a mature basis). A number of these cows have completed two consecutive lactation periods on alfalfa hay alone and a few of them are now completing their third successive lactation period on alfalfa hay alone. This means that some of these cows have been on alfalfa hay exclusively with no other feed of any kind for periods approaching 4 years. They are kept in barns and dry lots and the hay is weighed

to them twice a day. The amount that they refuse is carefully weighed back. Some of these cows have averaged in consumption almost 50 pounds of alfalfa hay per day and one cow has consumed as high as 72 pounds of alfalfa hay in a day. Their average consumption on a yearly basis has been 14,551 pounds of hay, about 7-1/4 tons per cow.

These same cows have also completed 15 yearly production records under full-feed conditions; that is, approximately 1 pound of grain was given for every 3 pounds of milk produced and in addition to grain they had all of the alfalfa hay, silage, (and in some cases pasture) that they would consume. Under this system of feeding these same cows produced an average of 19,066 pounds of milk and 642 pounds of fat (calculated to a mature basis). These figures indicate briefly that cows fed a ration consisting entirely of a good quality of hay alone will produce on the average approximately 70 percent as much as they will produce when fed a full-grain ration. So far as known, there has been no breeding trouble as a result of the exclusive alfalfa ration. The cows lose weight rapidly following calving but regain this weight rather rapidly at a later period so that their final pre-calving weight for the next lactation period is usually about the same as it was before. In fact, the average gain in weight over a yearly period by these cows has been 26 pounds.

In summarizing this feeding work it was found that cows fed a limited-grain ration produced approximately 90 percent as much as they produced when full fed on grain; when fed roughage alone (including alfalfa hay, silage and pasture) they produced 77 percent as much as when fed the full-grain ration; and when fed alfalfa hay alone they attained approximately 63 percent of their production under full-feed conditions.

According to these figures if a farmer milking 15 cows that average 300 pounds of fat per year, or a total of 4,500 pounds, on full-grain feed wishes to reduce his production 10 percent (or 450 pounds) he could reduce the amount of grain to a ratio of 1 to 6 and attain this reduction, bearing in mind of course that the amount of roughage needed would be greater. If he desired to eliminate grain feeding all together and is in position to feed his cows all the good alfalfa hay, silage, and pasture grass they will take he can expect a reduction of approximately 23 to 25 percent from full feeding by this method. In this case his herd would produce 3,375 pounds of butterfat or an average of 225 pounds of butterfat per cow.

Nutrients Cheaper in Pasture and Roughage

The cheapest source of nutrients for dairy cattle is good pasture. In seven districts of the United States where studies were made of the cost of producing market milk, pasturage provided nearly 1/3 of the total sustenance of the cows but the cost was only 1/7 of the total feed cost. At Beltsville, Md., the digestible nutrients in pasturage were produced for 48 cents a hundred pounds while those in corn silage and alfalfa hay on the same or similar land were produced at a cost of $1.22 a hundred pounds. Clover and timothy and Kentucky bluegrass pastures in Southern Indiana produced total digestible nutrients at a cost of $.44 per 100 pounds which is less than that of any other crop in this or any other region. The New Zealand dairyman, raising grass only, produced butterfat for 2/3 what it costs the Wisconsin dairyman, and he does this on land that has a 50 percent higher valuation. In the Oregon coast counties, dairymen, depending largely on pasturage, produce butterfat cheaper than the dairymen of the Williamette valley who feed more grain and hay. While few determinations have been made anywhere on the actual cost of pasturage as compared with other crops it is evident that good pastures and economical production are closely related.

The next cheapest source of nutrients is alfalfa hay. It is cheaper than other hay crops and small grains because it yields more to the acre. It is cheaper than corn because it requires less labor, besides yielding more in some regions than corn. But even in the Corn Belt where corn may out-yield the alfalfa, the alfalfa produces total digestible nutrients at a less cost.

The next cheapest source of nutrients may be either the biennial or perennial hay corps, such as timothy and red clover, or it may be corn, depending largely upon whether the region is better adapted to corn or to hay crops.

The most expensive nutrients are obtained in the small grain crops, such as wheat, oats and barley.

In order to cut the cost of milk production to the minimum the dairyman should make the fullest possible use of pasture and he should, if possible, raise alfalfa.

Pastures produce less nutrients than corn, alfalfa, or any of the hay crops. Every acre of these crops that is converted to pasture means a reduction in stock feed. Pastures not only produce less feed, but figuring the farmer's time at the prevailing wage, pastures produce cheaper feed. The conversion of these grain and hay crops to pasture is, therefore, a practicable method of bringing about a reduction of dairy products, and at the same time this reduction should not lower the farmer's net income.

While the more extensive use of alfalfa will not reduce the quantity of feed produced, it is desirable, nevertheless, to encourage the raising of alfalfa. First because it is a cheap winter feed, and second because its liberal use will make possible a reduction in the quantity of grain fed, thus cutting the cost of producing milk.

Table 1 shows the average yield of various grain and hay crops in the United States as reported by the U. S. Census, and estimated yield of total digestible nutrients per acre as calculated from the average analyses of these crops.

Table 2 shows the average yield of various grain and hay crops in five different regions of the United States, the estimated yield of total digestible nutrients, and the cost of producing the nutrients per 100 pounds.

Table 1.

Crop	Average yield per acre	Total digestible nutrients	
	Bu. or Tons	Pounds	
Corn, ears	28.2	1542	
Corn stover	.84	438	considered 1/2 edible
Corn silage	5.6	1982	
Barley	22.8	869	
Oats	29.6	667	
Oat straw	.88	401	considered 1/2 eaten
Wheat	14.1	678	
Alfalfa	2.61	2694	
Clover	1.46	1468	
Clover & timothy	1.40	1294	
Timothy	1.26	1222	
Annual legumes	1.02	1093	
Sudan grass, Millet and Johnson grass	1.23	1264	
Lespedeza	1.12	1169	
Pasture, Clover and Timothy (Est.)		958	

Table 2

New York 1914-18

Crop	Average yield per acre	Total digestible nutrients	
		Pounds	Cost per 100 pounds
	Bu. or Tons		
Corn, grain	27.8	1272	$3.98
Corn, silage	6.1	2159	2.09
Oats	35.8	807	3.85
Barley	25.7	980	3.49
Wheat	23.6	1134	2.98
Alfalfa hay	2.6	2683	1.03
Hay	1.53	1530	1.13
Pasture on hay land (Est.)		1132	
Iowa, Iowa County, 1925-27			
Corn, grain	57.3	2622	$1.05
Corn, silage	8.2	2974	1.25
Oats	44.1	993	1.78
Barley	33.4	1262	1.53
Wheat	22.6	1086	2.06
Clover & timothy	1.2	1098	1.47
Alfalfa hay	2.7	2786	.70
Sweet clover	2.6	2636	1.07
Pasture, Clover and Timothy (Est.)		813	
Colorado, 1917			
Oats	51.3	1156	$3.62
Barley	50.3	1917	2.19
Wheat	34.1	1644	2.67
Alfalfa	3.31	3416	1.01
Oregon, Williamette Valley (3-year average)			
Clover hay	2.0	2036	$ .76
Alfalfa hay	3.8	3922	.84
Vetch and oat hay	2.3	2167	1.06
Vetch and oat silage	7.9	2686	1.28
Corn silage	5.7	2018	2.13
Kale	18.1	2643	2.60
U. S. Dairy Farm, Beltsville, Md.			
Corn silage (12 years)	8.63	3056	$1.23
Alfalfa hay (12 years)	2.1	2166	1.22
Soybean hay (4 years)	1.33	1430	1.61
Pasture grass (13 plots or fields)		1798	.48

Pastures and Legumes Conserve Soil Fertility

Any long-time plan looking to the betterment of agriculture must take into consideration the conservation of soil fertility. The value of the fertilizing constituents taken from the soil is least with the crops composed wholly or partly of legumes. It is estimated that pasturage, provided it is made up of 35 percent or more of legumes, will take less of the fertilizing constituents from the soil than any other crop, though some of the lower yielding legume hays will remove only a little more. Alfalfa, on account of its greater yield will remove more than twice the fertilizing constituents that the other legumes or mixed clover and timothy will remove. The corn ears, the small grains and the non-legume hays rank next to the lower yielding legumes. Corn removes more fertilizing constituents than any other crop if the whole corn plant is taken off the land either as ears and stover or as silage.

The following tabulation shows the estimated value of fertilizing constituents taken from the soil by various crops:

Crop	Yield per acre (U.S. Census) Bu. or Tons	Value of fertilizing constituents taken from the soil. 1/
Corn, ears	28.2	$4.40
Corn, stover	.84	3.17
Corn silage	5.6	7.52
Barley	22.8	4.57
Oats	29.6	5.39
Wheat	14.1	3.83
Alfalfa hay	2.61	5.90
Clover hay	1.46	2.40
Clover and timothy hay	1.40	3.71
Timothy hay	1.26	4.82
Annual legumes	1.02	2.51
Sudan grass, millet, Johnson grass	1.23	5.72
Lespedeza	1.12	2.88
Pasture, clover and timothy (Est.)		2.31

1/ These values are based on the following fertilizer prices:

Nitrate of soda, $40 per ton; Superphosphate (16%), $14 per ton; Nitrate of potash, $40 per ton.

Pastures and Perennial Hay Crops Lessen Erosion

Erosion on some soils has been sufficiently extensive to practically ruin the land for agricultural purposes. The Agricultural Adjustment Administration, realizing this enormous dissipation of natural resources, has set up an interdepartmental agency to find out the best means of checking erosion and to put the findings into practice.

Recent activities of the United States Department of Agriculture and the State experiment stations have provided some very significant data in regard to the losses of soil on land in cultivated crops as compared with that on similar land protected by a cover of grasses or legumes. It has been found that land planted to cotton on a 7-percent slope in Oklahoma or Texas loses annually from 14 to 17 tons per acre of the best topsoil. Where this land is in grass, the annual loss is only 0.04 to 0.5 ton per acre. The run-off (rainfall loss) on the cotton land is 13 percent, while on land in Bermuda grass it is less than 2 percent. The decaying grass roots keep the soil porous and create a favorable condition for the absorption of moisture.

Land planted to corn on an 8 to 10-percent slope in Missouri and North Carolina loses 15 to 17 tons of soil per acre annually, while that growing bluegrass or lespedeza loses only 0.8 to 0.9 ton per acre. Similar results were obtained in a comparison of the native-grass sod and clean-tilled kafir in central Kansas. The loss from the land growing kafir was 21 tons of soil per acre and 12 percent of the rainfall. On natural-grass sod the loss was 5 pounds of soil per acre and 0.5 percent of the rainfall.

These results, obtained by actual measurements in different sections of the United States, indicate the usefulness of grasslands not only in preserving soil resources but also in protecting storage reservoirs from destruction through

the gradual accumulation of silt. Many such reservoirs have been constructed for irrigation purposes and power development. The capacity and consequent usefulness of these expensive public utilities is lessened each year by the movement of soil from the surrounding watershed. Any increase in pasture acreage will tend to extend the period during which these reservoirs will fulfill their purpose.

Improving Pastures

Undoubtedly a large part of the 40 million acres of land taken out of cultivation by the various crop curtailment programs will be seeded to permanent pastures and legumes. The suggested program for curtailing dairy production by feeding cows more high-quality roughage and less grain should emphasize not only the advantage of providing a large proportion of this roughage in the form of pasture grasses, but the importance of improving pastures. The old practice of allowing a piece of waste land to revert to grass and calling it pasture regardless of whether or not it had substantial grazing should be discarded by good dairymen. Furthermore, attention must be directed to the beneficial effects of proper fertilizers, rotational or controlled grazing, and a systematic practice of cutting surplus pasture grasses while they are immature and saving this surplus in the form of hay or silage.

The average permanent pastures of the United States are notoriously poor, first because they are usually located on land which is rough,. stony, wet or poor, and second, because the natural fertility of the soil has not been maintained. Although it is usually possible to make such land produce at least fair crops of pasturage.

The dairy farmer may find need for more pasturage than his farm produces. If he does there are certain well established principles to guide him in improving

his pastures. In the first place, the soil must be reasonably fertile. Pasturage like any other crop, will not do well on a poor soil. Whether this fertility is to be obtained through application of manure, lime, commercial fertilizers, or a combination of all is something to be decided by those familiar with his particular conditions. In the second place, permanent pasturage should be made up in part of a legume in order that the nitrogen content of the soil may be maintained. Soil conditions should at all times be kept favorable to the growth of the legumes. Use nitrogen fertilizers sparingly, if at all. Once a pasture is brought to a satisfactory state of productivity it can be kept so at only a small cost. Third, pastures should be neither under grazed nor overgrazed - both practices are detrimental. Fourth, weeds and brush must be kept down. As a rule, the better the pasture the less the trouble from weeds and brush, but if they do come in mowing, cutting and grubbing are practicable remedies.

High-Quality Roughage Important

In growing roughage crops the American dairyman has failed to take advantage of the well established fact that roughage crops cut and cured at early stages of maturity are more nutritious and palatable than when cut at mature stages. This applies to pasture grasses as well as to legume hays. That the farmers of the Netherlands, Australia, and New Zealand appreciate this fact is evidenced by their general practice of cutting or grazing their pasture grasses while they are immature. In these countries, if more grass is available than the cows can utilize during the flush periods, the immature grasses are cut and cured for hay, or they are put in the silo. These early-cut grasses often contain as high as 20 percent of crude protein, with a correspondingly low fiber content, and compare favorably in nutrient content to good grain mixtures.

In view of the widespread interest of the American dairyman in the utilization of greater amounts of roughage as a means of cutting down dairy production, the following results of experimental work are of fundamental value.

For several years the Bureau of Dairy Industry has been carrying on experiments at its field stations whereby pasture grasses have been cut at different stages of maturity and made into either hay or silage. This hay and silage has been fed to dairy cows and attempts have been made to measure the comparative feeding value of the grasses as affected by stage of maturity when cut.

Pasture grass was cut from irrigated plots at periods varying from 43 to 80 days' growth and made into hay and silage. Samples of the grass analyzed showed a crude-protein content varying from 17.1 percent for the early-cut grass to only 9.6 percent for the most mature. The grass cut at 43 day's growth contained almost double the amount of crude protein as that cut at 80 days' growth. The crude fiber content of the early-cut grass was only 24 percent as compared to 36 percent for the most mature.

In the feeding experiments dairy cows were fed nothing but this hay or silage. The group of cows on grass hay alone consumed a daily average of 44 pounds of grass hay. But they always preferred the less mature grass hay and consumed an average of 47 pounds per day as compared to only 37 pounds per day for the mature hay. The same thing held true for the grass silage, the cows consumed a daily average of only 83 pounds per day of silage made from grasscut at 80 days' growth, while they consumed 136 pounds per day of grass silage made from grass that represented 43 days' growth.

The milk production of the cows on both the grass hay and the green silage held up remarkably well, especially when they were getting hay or silage made from the early-cut grass. The hay-fed cows averaged 41 pounds of milk per day and they consumed enough dry matter and nutrients to meet these requirements.

The results of these experiments indicate that cows will produce remarkably well on rations made up of roughage alone providing the grass for making the hay or silage is cut at early enough stages of maturity and is properly cured. The dairyman may have his land largely in pasture crops and legumes. He can graze his animals but the surplus growth of grass and legumes may be saved in the form of hay or silage to be fed as supplements to the pasture and to form all or the main part of the ration during that part of the year when grazing is not available. Inexpensive trench silos can be utilized to good advantage in ensiling these crops.

It is important, however, that for milking cows the grasses, whether made into hay or silage, be cut at an early stage of maturity. The cows should also be accustomed to eating large amounts of roughage. Experiments were carried on with mixed pasture grasses grown under irrigation, cut at different stages of growth, and fed to four Holstein cows kept in the barn. The grass was weighed and fed in the green form. The least mature grass averaged only 25 days' growth and the protein content was 19.5 percent. The most mature grass averaged 47 days' growth and contained only 13.1 percent crude protein.

The four cows fed nothing but this green grass, consumed an average of 137 pounds per day. One cow averaged 152 pounds per day for 55 days, and consumed as high as 218 pounds of green grass in one day. The milk production of these cows held up remarkably well. Two of the cows averaged more than 35 pounds of milk per day. The declines in production were no more than the decline expected under a full-grain system of feeding. These cows had the capacity to consume sufficient grass to meet their needs for body maintenance and for producing 35 to 40 pounds of milk per day. The grass they consumed was for the most part highly nutritious, due to its being cut at an immature stage. Had it been more mature and less nutritious it is probable that the cows could not have consumed enough to obtain nutrients sufficient for such heavy production.

A second group of cows was allowed to graze a similar plot where the grass was abundant. Apparently, these cows did not consume as much grass as the group that had the grass cut and brought to them. Their decline in production was somewhat greater, also they lost more in body weight. Possibly the physical effort of grazing was so great that the cows did not work hard enough to get as much grass as they needed. Although they produced at a somewhat lower rate than the cows fed the green clipped grass, they held up remarkably well in production.

These two grass-feeding experiments definitely point out that if grass is grazed or cut at early stages of maturity, cows can eat sufficient quantities for comparatively heavy production. No other feed is necessary if the grass is immature and abundant.

Experiments have also been carried on with Sudan grass as a hay and pasture. As a hay crop Sudan grass has not always proved the best. Good yields have been obtained ordinarily but the hay has practically always been low in protein content, coarse and rather unpalatable. In fact, it has not been uncommon for the cows to refuse as much as 35 percent of the hay feed.

In most sections, it is the practice to cut Sudan grass for hay when the seed is in the milk or soft dough stage. The grass at this stage may stand 5 or 6 feet tall, depending upon growth conditions. The stems are large, full of juice, and the hay is difficult to cure. The protein content may be only 5 or 6 percent, or lower.

In order to compare the yields, nutrients produced per acre, and feeding value of Sudan-grass hay cut at different stages of maturity, plots were cut at the following stages of maturity: (1) First-heads-out stage; (2) Full-head stage; and (3) Milk or soft-dough stage.

The hay was carefully cured, weighed and samples were taken for chemical analyses. During the winter this hay was fed to three carefully selected groups

of milking cows. To a fourth group of cows, a very good grade of alfalfa hay was fed as a check. In other words, the three different stages of Sudan-grass hay were compared to each other and also to alfalfa.

There was little difference in yield per acre of the air-dry Sudan-grass for the three stages, the average yield being approximately 2 tons per acre.

The percentage of crude protein was a different story. Hay cut when it headed out contained an average of 12 percent crude protein; that cut when fully headed contained approximately 9 percent protein, while that cut when the seed was in the soft dough stage analyzed 7 percent crude protein. Good alfalfa hay contained about 16 percent protein. First-heads-out hay yielded 404 pounds of crude protein per acre, fully headed hay yielded 318 pounds and hay cut in the soft dough stage yielded only 285 pounds of crude protein per acre. In other words, the first-heads out hay produced 119 pounds, or 42 percent more crude protein per acre than the hay cut in the soft-dough stage. It would require almost 1½ acres of Sudan-grass hay cut in the soft-dough stage to yield the same amount of crude protein as 1 acre cut in the first-head-out stage. About 600 pounds of grain mixture is required to furnish 119 pounds of crude protein. At $30.00 per ton this 600 pounds of grain would cost $9.00. On this basis, an acre of Sudan-grass hay cut when the first heads appear is worth $9.00 more than an acre of Sudan-grass cut when the seeds are in the soft-dough stage.

Over 28-day feeding periods, cows consumed an average of 31 pounds of first-heads-out hay per day, 26 pounds of the soft-dough hay and 30 pounds of the alfalfa per day. In other words, they ate more of the early-cut Sudan-grass hay than they did of the good alfalfa. However, they refused to eat 18 percent of the first-heads-out hay, and only 2 percent of the alfalfa. This indicates that while cows will eat as much first-heads-out Sudan-grass as good alfalfa, it will take about 116 pounds of the Sudan-grass to replace 100 pounds of the alfalfa

on the actual consumption basis. This is due to the larger unpalatable stems of the Sudan-grass as compared to alfalfa.

The first-heads-out Sudan-grass hay was superior to the hay cut at later stages of maturity in maintaining milk yields.

Later three Holstein cows were fed for entire lactation periods on nothing but Sudan-grass hay cut at the first-heads-out stage. They consumed an average of 10,843 pounds - almost 5½ tons of the hay per cow and produced an average of 8,258 pounds of milk containing 261 pounds of butterfat. One of these cows was considered abnormal - producing only 196 pounds of fat, the other two averaged almost 300 pounds of butterfat each. A similar group of 3 cows, fed nothing but a good grade of alfalfa hay, consumed 13,396 pounds of hay on the average and produced 342 pounds of butterfat.

Taking everything into consideration the Sudan-grass hay cut in the early stage was far superior to that cut in later stages (in yield of protein per acre, palatability and feeding value) and compared with alfalfa in many respects. It is believed that the results secured with Sudan-grass are applicable to any of the non-legume hays, and that a nutritious and palatable hay can be made from so-called inferior grasses if they are cut at early stages of maturity and properly cured.

EFFECT OF DIFFERENT SYSTEMS OF FARMING AND FEEDING UNDER TWO SYSTEMS OF MARKETING THE MILK

(Sussex County, N. J.)

A survey of dairy farms in Sussex County, New Jersey, in 1930 showed that the average dairy farmer kept 30 cows, for which he grew all the roughage and purchased all the grain. He received an average of $3.08 a hundred pounds for his milk and paid an average of $48 a ton for grain. Grain was fed to cows at the rate of 1 pound to each 2½ pounds of milk produced. In 1930 this average Sussex County dairy farmer's income from sale of milk was $4,694.69 over cost of grain. These facts are set forth in New Jersey Agricultural Experiment Station Bulletin 542.

Using the principle developed in our experimental feeding work, which indicates that a dairy cow fed a limited-grain ration will produce approximately 90 percent as much milk as when she is fed a full-grain ration (provided she is fed a good quality of roughage) and that when fed a ration consisting entirely of a good quality of roughage she will produce approximately 70 percent as much milk as when fed a full-grain ration; and using the average yield of milk produced per cow and the average yields of crops on these New Jersey farms as set forth in Bulletin 542 we have studied the possibilities of increasing the net returns of farmers situated under these circumstances, by cutting down or eliminating purchased grains under the following systems of farming and feeding.

A. Full-grain feeding (1:2½)

1. All grain purchased.
2. All grain home grown.

B. Limited-grain feeding (1:6)

1. All grain purchased.
2. All grain home grown.

C. Pasture and roughage, but no grain.

1. All roughage home grown.

Since the growing of home-grown grains to substitute for purchased grains, or the production of additional roughage to supply nutrients that have heretofore been purchased in grain, means more acreage in these crops per cow than is the case under the present system of cropping and feeding, the number of cows must be reduced per farm to fit the amount of nutrients that can be grown under the different systems of feeding. Thus where a full-grain ration is purchased, less roughage is needed per cow, and 30 cows are kept per farm; but if the full-grain ration is grown on the farm more acres must be devoted to growing feed per cow, and only 19 cows are kept per farm; when the limited-grain ration is purchased 26 cows can be kept, and when it is home grown only 22 cows can be kept per farm; when the cows are fed a ration consisting of roughage, sufficient feed can be grown for 25 cows.

When we apply the reduced rate of milk production on the limited-grain ration and on the roughage rations, to the number of cows for which feed can be grown under each of these systems, and use the amount of milk produced by the 30 cows on the purchased full-grain ration as 100 percent production, the relative percentage of milk produced under the different systems of feeding is as follows:

Full-grain ration	- purchased (30 cows)	100 percent	milk production 1/
Full-grain ration	- home grown (19 cows)	63.3 "	" "
Limited-grain ration	- purchased (26 cows)	77.8 "	" "
Limited-grain ration	- home grown (22 cows)	65.9 "	" "
Roughage-alone ration	- home grown (25 cows)	58.3 "	" "

1/ About 7,500 pounds per cow.

Net returns, over cost of purchased feed, from these different systems of feeding and farming have been calculated for 1930 and 1934.

The 1930 returns were calculated only on the basis of a uniform or blended price for milk, averaging $3.08 a hundred, and $48 a ton for grain.

The 1934 returns were calculated on the basis of a uniform or blended price for milk, averaging $1.48 a hundred, and $30 a ton for grain; and also on the basis of variable prices that would be received for milk under a base-surplus plan of selling.

For 1930, at the uniform rate of $3.08 a hundred for milk, and $48 a ton for grain, the estimated returns over cost of purchased feeds, for the different systems of feeding would be as follows:

Limited-grain ration - purchased (26 cows)	$4,743.49
Full-grain ration - purchased (30 cows)	4,694.69
Limited-grain ration - home grown (22 cows)	4,607.68
Full-grain ration - home grown (19 cows)	4,431.13
Roughage-alone ration - home grown (25 cows)	4,081.00

For 1934, at the uniform rate of $1.48 a hundred for milk and $30 a ton for grain (as of March 1934), the estimated returns over cost of purchased feeds, for the different feeding systems would be as follows:

Limited-grain ration - home grown (22 cows)	$2,214.08
Limited-grain ration - purchased (26 cows)	2,174.77
Full-grain ration - home grown (19 cows)	2,129.25
Roughage-alone ration - home grown (25 cows)	1,961.00
Full-grain ration - purchased (30 cows)	1,923.32

The farmer's price for milk, under either the blended-price system or the base-surplus system of selling, is based on the percentage of milk selling for different purposes. In the New York milk shed 50 percent of the total milk supply sells as fluid milk at $1.95 (March 1934) net per hundred, 20 percent sells as table cream at $1.25 net per hundred, and 30 percent sells for manufacturing purposes at $.85 net per hundred. The blended price on the basis of these figures is $1.48 net per hundred. (The figures on the distribution of milk are based on the percentage used in each class during the last 9 months.)

When a farmer sells all his milk at a uniform price rate, as would be the case under the blended-price plan, the individual farmer does not benefit by reducing the total output of milk from his farm, unless a sufficient number of farmers in the milk shed also reduce their output to a point, where the milk used for manufacturing purposes from that entire shed is greatly reduced or eliminated.

Under the base-surplus plan, however, if the individual farmer reduces his total output to the amount of his base he increases his price rate per

hundred because a larger percentage of his milk goes for the higher-price product, fluid milk or table cream.

Under the base-surplus plan, according to these calculations, the farmer feeding roughage alone would produce only 58 percent as much milk as he would by feeding a full-grain ration of purchased concentrates and would receive $1.85 a hundred for his total milk output; under the full grain, home-grown system he would produce 63 percent as much milk and would receive $1.80 a hundred; under the limited-grain, home-grown plan he would produce 66 percent as much and would receive $1.78 a hundred; under the limited-grain purchased plan he would produce 78 percent as much and would receive $1.66 a hundred; under the full-grain feeding of purchased grains (producing the greatest amount of milk per farm, or 100 percent) the rate would be $1.48.

Under the base-surplus selling plan, at these rates for milk, the different systems of feeding and farming show the following returns over cash outgo for purchased grains:

Limited-grain ration - home grown...(22 cows)...		$2,662.88
Full-grain ration - home grown...(19 cows)...		2,589.62
Limited-grain ration - purchased....(26 cows)...		2,493.01
Roughage-alone ration- home grown...(25 cows)...		2,451.25
Full-grain ration - purchased....(30 cows)...		1,923.32

In all these calculations no consideration has been given to the established fact that it is cheaper to produce food nutrients in the form of roughages than in grain; that growing roughage crops reduces the amount of fertilizing constituents removed from the land by the crop or by soil erosion; nor to the savings that may be effected under the different systems of feeding and farming, by reductions in capital investment and labor when fewer cows are kept.

To carry this analysis to a final conclusion differences in overhead and labor costs for the varying number of cows kept under the different systems should be considered; also the differences in costs of producing nutrients in home grown grains and roughages; as compared to their cost in purchased form and a consideration of the losses of soil fertility under the different systems.

SUPPLEMENTARY INFORMATION

The following publications and mimeographed pamphlets supporting the foregoing statements may be obtained from the Bureau of Dairy Industry, U. S. Department of Agriculture, Washington, D. C.:

Roughage Feeding Series:

No. 1, BDIM-625, A study of Certain Phases of the Economics of Dairy-Cattle Feeding.

No. 2, BDIM-626, Roughage Rations for Dairy Cows Make Less Milk and More Profit.

No. 3, BDIM-627, A Study of the Effect of Modified Systems of Feeding on Milk Production and Net Returns over Cash Outgo for Purchased Feeds, Based on Published Data Obtained on 98 Dairy Farms in Sussex County, New Jersey.

F. B. 1604, Dairy Herd-Improvement Associations and Stories the Records Tell.

Cir. 114, Within the Breed the Big Cows Excel.

Leaflet 3, Improved Sanitation in Milk Production.

D. C. 129, Milk for the Family.

F. B. 876, Making Butter on the Farm.

T. B. 381, Feeding Value for Milk Production of Pasture Grasses When Grazed, When Fed Green, and When Fed as Hay or Silage.

T. B. 352, Sudan Grass as Hay, Silage, and Pasture for Dairy Cattle.

Cir. 274, Comparison of a Trench Silo with an Upright Silo.

F. B. 578, The Making and Feeding of Silage.

M. P. 194, Pasture Handbook.

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